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Disease Resistance of Potatoes

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*In cooperation with Bu. An. Ind., U. S. Dept. Agr.

BULLETIN 179: DISEASE RESISTANCE OF POTATOES

Third Report[1]

By WILLIAM STUART

NOTE.—The completion of the studies reported in this bulletin was made possible through the courtesy of the Chief and of the Horticulturist of the Bureau of Plant Industry of the Department of Agriculture, who generously allowed the former station horticulturist, the author of this bulletin, time to pursue his studies, after he had entered the office of horticultural investigations in that Bureau. The Station is indebted to these gentlemen for the courtesy.

J. L. HILLS, Director.

INTRODUCTION

Disease resistance is a term used to designate certain qualities in a plant which tend to enable it to resist the attack of a fungus or bacterial disease. Such resistance may be absolute, partial or entirely wanting. A variety of potatoes, for example, may possess marked vine resistance to fungus attacks and yet at the same time its tubers may be very susceptible thereunto. It may be resistant to the so-called early blight (*Alternaria solani*) and yet fall an easy prey to late blight (*Phytophthora infestans*), or vice versa. It has been observed that disease resistance of the vine is generally associated with a stiff, upright, woody stem, and rather small, firm, stellate or hairy leaves. Tuber resistance is probably associated with some physiological or chemical differences in the cell protoplasm, or with certain morphological differences in the epidermal cell structure.

The trials upon the results of which the present report is based were undertaken in 1905, when this Station entered into cooperative relations with the Bureau of Plant Industry of the United States Department of Agriculture with a view of making further study of this problem. Through this arrangement the Station came into possession of a considerable collection of so-called disease resistant European varieties, selected and purchased by Jones[2] in 1904, as well as of a number of the leading American varieties.

The first report[3] consisted of a preliminary statement of studies pursued by the writer prior to 1905; the second[4] gave the results of a single season's observations upon disease resistance to late blight displayed by the vine and tubers of the European and American varieties. The fact that late blight was unusually prevalent and virulent in 1905 made the test a severe one, for the plants were purposely left unsprayed in order that their relative resistance to this and

[1]Vt. Sta., Buls. 115 (1905), 122 (1906).
[2]Jones, L. R.—Disease Resistance of Potatoes.—U. S. Dept. Agr., Bu. Plant Ind., Bul. 87 (1905). Abstr. Vt. Sta., Rpt. 18., pp. 264-267 (1905).
[3]Vt. Sta., Bul. 115 (1905).
[4]Vt. Sta., Bul. 122 (1906).

other fungous diseases might be observed. The results secured indicated that both the vines and tubers of certain varieties possessed marked resistance to the attacks of the late blight fungus. The data obtained showed that the foreign varieties as a whole were less subject to tuber rot than the American varieties. Classifying them in accordance with their origin they ranged in order as follows: Dutch, German, Scotch, English, French and American. The poor showing of the American varieties may perhaps be attributed to the fact that American potato specialists have not thus far laid much stress upon the development of disease resistant varieties. Their main desire has been to originate varieties possessing good commercial qualities without much regard to whether they were or were not disease resistant.

While the outcome secured in 1905 was an emphatic one, it seemed worth while to repeat the work in 1906, with a view of securing further evidence. But late blight was almost non-existent in Vermont that year; and so the trials were again repeated in 1907. Again the late blight was conspicuous by its absence. Believing that the importance of the problem warranted continued effort looking towards its solution, yet further trials were carried out on a somewhat more extended scale in 1908, 1909, 1910, 1911 and 1912. But these tests were also unproductive of results, owing to the continued absence in the trial fields of infection from the late blight fungus. The 1911 plots were placed at Middlebury, Vermont, and the 1912 crop was grown at Houlton, Maine. These localities, particularly the latter, were chosen in the hope that better conditions for late blight infection would be encountered. The present statement, therefore, is a negative one, so far as any evidence touching disease resistance to late blight is concerned, and after seven consecutive seasons' trials, during which no vestige of the once destructive malady appeared the further prosecution of the trials under station auspices is abandoned.

It seems desirable, however, to report upon the following studies carried on coincidently with the late blight observations, viz.:

(1) Vine resistance to early blight.
(2) Tuber resistance to scab.
(3) The growing of seedling potatoes.
(4) Desirable types of potatoes.
(5) Varietal response to bordeaux sprays.
(6) Value of foreign varieties.

1. VINE RESISTANCE TO EARLY BLIGHT

(*Alternaria solani*, E. & H., Jones and Tracy)

While the ravages of the early blight have never been regarded as seriously as have been those of the late blight (*Phytophthora infestans DeBy*) for the reason that tuber decay does not follow leaf infection, the fact remains that it may and often does very materially reduce the tuber yields. The writer has personally observed a field of potatoes in Franklin county so seriously attacked by early blight that the foliage was practically destroyed and the vines prematurely killed in mid-August. Such severe cases are exceptional in Vermont, but one often sees a considerable proportion of the foliage of unsprayed plants infected with early blight, and the injury in such cases must be relatively large.

In studying the relative vine resistance of the several varieties, an attempt was made to estimate the percentage of the leaf infection during the seasons of 1905 to 1909. In all cases these estimates represent the judgment of the observer, based on a careful scrutiny of the plants of each variety. He occasionally checked his judgment by that of a second party. No attempt was made to determine the percentage of actual infection of the leaves. The writer appreciates that this method of percentage determination is not absolutely accurate, but it was a physical impossibility to make actual counts of all leaf infected areas of each plant, and to have done less than this would not have enhanced the accuracy of the work. On the whole, however, it is felt that the observations were fairly comparative and that they afford a reasonably accurate index of the relative susceptibility or immunity of each variety.

The data presented in table I show a decided variation in the amount of infection in the different seasons.

TABLE I—PERCENTAGE OF FOLIAGE AFFECTED BY EARLY BLIGHT

Accession number	Variety	1905	1906	1907	1908	1909
500	Geheimrat Theil	0	75	40	0	10
501	Sophie	0	60	10	2	0
502	Dabersche	2	75	75	0	6
503	Richter's Imperator	2	90	50	25	15
504	Magnum Bonum	5	97	50	10	0
505	Irene	0	90	50	0	0
506	Professor Maerker	0	97	10	25	0
507	Silesia	2	95	25	40	0
508	Max Eyth	0	75	5	0	0
509	Mohort	3	80	10	25	0
510	Gastold	2	97	35	30	0

TABLE I—CONTINUED

Accession number	Variety	1905	1906	1907	1908	1909
511	President Kruger	0	95	15	40	0
512	Professor Wohltmann	2	50	12	5	0
513	Topaz	8	50	25	0	0
514	Boncza	0	80	10	0	0
515	Leo	2	90	50	40	0
516	Fuerst Bismarck	3	75	5	10	0
517	Apollo	3	50	5	5	0
518	Gelbfleischige sp. Kartoffel	2	40	50	1	0
519	Eigenheimer	0	80	15	0	0
520	Landskroon	5	50	75	0	0
521	Eureka	6	75	60	5	0
522	Malador	0	25	25	1	0
523	Daisy	2	95	35	5	0
524	Belle de Fontenay	2	10	50	..	..
525	Brandale	5	50	10	..	..
526	Early Rose	15	97	25	..	..
527	Chave (Shaw)	2	75	75	..	..
528	Belle de Juillet	12	90	90	..	..
529	Quarantaine de la Halle	3	97	20	..	..
531	Ninety-fold	10	90	85	..	..
532	Epicure	5	75	60	..	..
533	Supreme	10	60	60	..	..
534	Windsor Castle	0	80	15	..	..
535	Discovery	0	60	10	..	..
536	Sir John Llewellyn	5	80	70	..	..
537	King Edward VII	2	90	60	..	..
538	Cramond Blossom	2	90	30	..	..
539	Charles Fidler	0	90	50	..	..
540	Factor	10	75	30	..	..
541	Duke of York	5	50	75	..	..
542	Langworthy	0	90	15	..	..
543	Tyne Kidney	0	90	10	..	..
544	Table Talk	1	90	15	..	..
545	Dalmeny Kidney	0	95	20	..	..
546	Crofter	0	90	25	..	..
547	Scottish Queen	1	80	20	..	..
548	Premier	1	90	15	..	..
549	Northern Star	2	97	15	..	..
550	Pink Blossom	0	90	10	..	..
551	Peace Maker	2	97	5	..	..
552	Dalmeny Red	0	97	25	..	..
553	Dalmeny Early	0	90	30	..	..
554	Spark's Express	1	80	20	..	..
555	Midlothian Early	10	40	95	..	..
556	Southern Queen	1	97	75	..	..
557	Webber's Early	5	95	50	..	..
558	White Blossom	2	80	15	10	0
559	Red Kidney	0	5	50	..	..
560	Money Maker	0	80	40	..	..
561	Sir Thomas Lipton	0	95	40	10	0
562	Radium	0	90	60	..	..
563	Acme	5	95	30	..	..
564	Heather Blossom	10	95	15	..	..
565	Discovery	0	80	25	..	..
566	Supreme	0	90	30	..	..
567	Ideal	5	80	20	..	..
568	Flour Ball	10	95	50	..	..
569	Ninety-fold	0	75	30	..	..
570	Evergood	2	90	25	..	..
572	Up-to-Date	0	97	20	..	..

TABLE I—CONTINUED

Accession number	Variety	1905	1906	1907	1908	1909
573	Northern Star	0	95	20	..	..
574	British Queen	0	90	40	..	..
575	Fidler's Seedling	0	75	..	..	..
576	Charles Fidler	5	97	50	..	..
577	Snowball	0	75	40	..	..
578	Monarch	0	99	10	..	..
579	Dumfrie's Model	0	90	10	..	..
580	Duchess of Cornwall	2	95	25	..	..
581	Factor	0	90	25	..	..
582	Improved Kidney	0	90	35	..	..
583	King Edward VII	5	90	..	..	..
584	Sir John Llewellyn	0	75	50	..	..
585	Cramond Blossom	0	95	25	..	..
586	Langworthy	10	95	15	..	..
587	Duke of Rothesay	5	99	75	..	..
588	Royal Kidney	0	90	50	..	..
589	Duke of York	10	95	98	..	..
590	Empress Queen	0	50	30	..	..
591	British Queen	0	95	25	..	..
592	Royal Kidney	10	90	50	..	..
593	Empire Kidney	7	99	25	..	..
594	Evergood	10	60	35	..	..
595	Goodfellow	2	95	30	1	0
596	Up-to-Date	0	90	25	..	..
597	Northern Star	2	90	15	1	0
598	Eldorado	0	80	60	1	0
599	American Wonder	12	99	90	..	..
600	Boss	10	99	70	..	..
601	Buffalo	5	95	50	..	..
602	Cambridge Russet	5	95	70	1	0
603	Clarke's Pride	12	98	90	..	..
604	Crine's Lightning	10	97	50	..	..
605	Dakota Red	2	90	60	1	0
606	Delaware	2	95	75	1	0
607	Doe's Pride	10	97	60	..	..
608	Enormous	2	95	40	30	0
609	Gem of Aroostook	5	80	90	50	0
610	Blight Proof	2	90	50	15	0
611	Green Mountain	2	95	65	35	0
612	Harris Snowball	7	97	40	20	0
613	Holborn Abundance	2	100	50	2	0
614	Ionia Seedling	2	99	40	1	0
615	Irish Cobbler	10	75	75	..	..
616	Keeper	3	95	40	0	0
617	Late Blightless	5	60	1	1	0
618	Norcross	10	95	80	1	0
619	Million Dollar	3	95	50	5	0
620	Norcross	6	97	60	..	..
621	Orange Blossom	2	95	35	..	..
622	Quick Lunch	10	98	85	..	..
623	Rural New Yorker No. 2	7	90	75	10	0
624	Scab Proof	0	90	40	..	..
625	Sir Walter Raleigh	4	95	75	15	0
626	Star-of-the-East	0	95	45	20	0
627	State of Maine	2	90	75	..	..
628	Swiss Snowflake	0	95	40	..	..
629	Gold Coin	0	97	80	..	..
630	Westfield	0	90	50	..	..
631	White Beauty	0	97	80	..	..
632	White Scotch King	2	97	40	..	..

TABLE I—CONTINUED

Accession number	Variety	1905	1906	1907	1908	1909
633	Unnamed Pink	0	95	40	10	0
634	Babbitt	2	50	75	..	..
635	Unknown variety	7	97	60	..	..
637	Alexander's No. 1 Red	0	90	20	15	15
638	Washington	5	97	60	..	..
639	Orlando	2	95	30	..	..
640	Alexander's No. 10	5	97	40	..	..
641	Gem	5	90	60	..	..
642	Pasadena	5	50	50	..	..
643	Alexander's No. 50	5	95	40	..	..
644	Alexander's No. 100	5	90	35	..	..
645	Havana	5	97	35	..	..
646	Reliance (Maule's)	1	75	15	..	..
647	Sunset	7	95	60	..	..
648	Alexander's No. 4	1	95	60	..	..
649	Alexander's No. 7	9	97	50	..	..
650	Alexander's Seedling	10	90	50	..	..
651	Alexander's Seedling	2	95	60	..	..
652	Prof. Maerker	0	99	1	5	0
653	Rural Blush	0	90	35	10	0

The heaviest infections occurred during the seasons of 1906, 1907 and 1908. In the latter season, however, there seems to have been relatively little uniformity in the amount of infection. The heaviest and most universal infection occurring during the seven years' trials was in 1908. If the several varieties under trial were to be judged as to their resistant powers by the 1906 record, it would seem as if there was little to be hoped for along this line, so far as these 150 varieties were concerned. Only two, Red Kidney (559) and Belle de Fontenay (524), both of foreign origin, can be claimed to have been found reasonably free from infection.

In view of the fact that wide percentage fluctuations occurred and that many of the varieties were dropped from the list in 1908 and 1909, it seems worth while to present in table II the average percentage of infection for the years 1905-1907 inclusive. In order further to facilitate the study of their relative immunity or susceptibility, the varieties have been arranged in percentage order, beginning with those showing the least infection. Such an arrangement is more or less arbitrary and does not necessarily afford a strictly true index of the actual disease resistant qualities of the sundry varieties; yet it is thought that it enables a closer comparative study of inherent disease resistant qualities to early blight than can be secured by the use of the data in the form in which it is presented in table I.

TABLE II—AVERAGE PERCENT OF EARLY BLIGHT LEAF INFECTION SEASONS OF 1905 TO 1907

Accession number	Name of variety	Percent of infection	Accession number	Name of variety	Percent of infection
522	Malador	16.7	586	Langworthy	40.
559	Red Kidney	18.3	591	British Queen	40.
517	Apollo	19.3	507	Silesia	40.7
524	Belle de Fontenay	20.7	538	Cramond Blossom	40.7
512	Professor Wohltmann	21.3	552	Dalmeny Red	40.7
525	Brandale	21.7	580	Duchess of Cornwall	40.7
617	Late Blightless	22.0	582	Improved Kidney	41.7
501	Sophie	23.3	584	Sir John Llewellyn	41.7
535	Discovery	23.3	653	Rural Blush	41.7
508	Max Eyth	26.7	595	Goodfellow	42.3
590	Empress Queen	26.7	634	Babbitt	42.3
513	Topaz	27.7	639	Orlando	42.3
516	Fuerst Bismarck	27.7	520	Landskroon	43.3
514	Boncza	30.	533	Supreme	43.3
646	Reliance (Maule's)	30.3	541	Duke of York	43.3
518	Gelbfleischige sp. Kartoffel	30.7	563	Acme	43.3
509	Mohort	31.	574	British Queen	43.3
505	Irene	31.7	624	Scab Proof	43.3
519	Eigenheimer	31.7	593	Empire Kidney	43.7
534	Windsor Castle	31.7	523	Daisy	44.
558	White Blossom	32.3	621	Orange Blossom	44.
543	Tyne Kidney	33.3	510	Gastold	44.7
550	Pink Blossom	33.3	561	Sir Thomas Lipton	45.
579	Dumfrie's Model	33.3	628	Swiss Snowflake	45.
652	Professor Maerker	33.3	633	Unnamed Pink	45.
547	Scottish Queen	33.7	644	Alexander's No. 100	45.
554	Sharp's Express	33.7	526	Early Rose	45.7
551	Peace Maker	34.7	608	Enormous	45.7
542	Langworthy	35.	632	White Scotch King	45.7
565	Discovery	35.	645	Havana	45.7
567	Ideal	35.	616	Keeper	46.
569	Ninety-fold	35.	532	Epicure	46.7
594	Evergood	35.	539	Charles Fidler	46.7
642	Pasadena	35.	588	Royal Kidney	46.7
544	Table Talk	35.3	598	Eldorado	46.7
548	Premier	35.3	626	Star-of-the-East	46.7
506	Professor Maerker	35.7	630	Westfield	46.7
597	Northern Star	35.7	643	Alexander's No. 50	46.7
578	Monarch	36.3	521	Eureka	47.
511	President Kruger	36.7	614	Ionia Seedling	47.
637	Alexander's No. 1 Red	36.7	503	Richter's Imperator	47.3
549	Northern Star	38.	515	Leo	47.3
500	Geheimrat Theil	38.3	640	Alexander's No. 10	47.3
540	Factor	38.3	612	Harris Snowball	48.
545	Dalmeny Kidney	38.3	555	Midlothian Early	48.3
546	Crofter	38.3	610	Blight Proof	49.
573	Northern Star	38.3	619	Million Dollar	49.3
577	Snowball	38.3	557	Webber's Early	50.
581	Factor	38.3	562	Radium	50.
596	Up-to-Date	38.3	592	Royal Kidney	50.
570	Evergood	39.	601	Buffalo	50.
572	Up-to-Date	40.	650	Alexander's Seedling	50.
529	Quarantaine de la Halle.	40.	502	Dabersche	50.7
553	Dalmeny Early	40.	504	Magnum Bonum	50.7
560	Money Maker	40.	527	Chave (Shaw)	50.7
564	Heather Blossom	40.	537	King Edward VII	50.7
566	Supreme	40.	576	Charles Fidler	50.7
585	Cramond Blossom	40.	605	Dakota Red	50.7

TABLE II—CONTINUED

Accession number	Name of variety	Percent of infection	Accession number	Name of variety	Percent of infection
613	Holborn Abundance	50.7	606	Delaware	57.3
638	Washington	50.7	623	Rural New Yorker No. 2	57.3
536	Sir John Llewellyn	51.7	556	Southern Queen	57.7
568	Flourball	51.7	625	Sir Walter Raleigh	58.
641	Gem	51.7	609	Gem of Aroostook	58.3
648	Alexander's No. 4	52.	629	Gold Coin	59.
649	Alexander's No. 7	52.	631	White Beauty	59.
604	Crine's Lightning	52.3	587	Duke of Rothesay	59.7
615	Irish Cobbler	53.3	600	Boss	59.7
611	Green Mountain	54.	531	Ninety-fold	61.7
647	Sunset	54.	618	Norcross	61.7
620	Norcross	54.3	622	Quick Lunch	64.3
635	Unidentified variety	54.7	603	Clarke's Pride	66.7
607	Doe's Pride	55.7	599	American Wonder	67.
627	State of Maine	55.7	589	Duke of York	67.7
609	Cambridge Russet	56.7			

It is interesting to note that 4 of the first 10 varieties in the list are also found among the 10 varieties most resistant to late blight, as shown in bulletin 122. The two lists are displayed herewith, the names occurring in both being italicized. The order of statement in each case is from least to greatest infection.

EARLY BLIGHT (1905-1907)	LATE BLIGHT (1905)
Malador	*Apollo*
Red Kidney	*Sophie*
Apollo	*Professor Wohltmann*
Belle de Fontenay	Irene
Professor Wohltmann	*Max Eyth*
Brandale	Daisy
Late Blightless (American)	Geheimrat Thiel
Sophie	Fuerst Bismarck
Discovery	Eureka
{ *Max Eyth*	
{ Empress Queen	President Kruger

Only one variety in the first list—Late Blightless—is of American origin and it, unfortunately, has no commercial importance. All the varieties in the second list are of foreign origin. The fact of greatest significance is this: that while the foreign varieties show a much higher degree of vine resistance to disease, they succeed so poorly under our climatic and soil conditions as to be practically worthless when viewed from a commercial standpoint. On the other hand, viewed from the standpoint of the plant breeder, they may

possess untold potentialities in the development of highly disease resistant American varieties.

In the preceding discussion of "vine resistance" no mention has been made as to the dates on which field observations were made, or as to their frequency. During the first four years rather careful watch was kept over the growing plants for the first evidences of disease. The varieties were usually planted in late May and the first notes on early blight during 1906 and 1907 were recorded on July 23. In the majority of instances some infection was noted by August 6, and the maximum infection occurred during the latter part of August or the first week in September. Table III displays the first recorded infection of each variety and the date on which the maximum amount of infection was noted. These data are only shown for 1906 and 1907, when early blight infection was relatively severe. The 5 or 6 intervening dates on which observations were made are omitted, for, aside from showing the rate of disease progression, they would be of little interest in the general study.

III—DATE OF FIRST APPEARANCE AND MAXIMUM EARLY BLIGHT INFECTION 1906 AND 1907

Name of variety	1906				1907			
	Date of first appearance	Percent of infection	Date of maximum infection	Percent of infection	Date of first appearance	Percent of infection	Date of maximum infection	Percent of infection
Geheimrat Theil	July 24	1	Aug. 28	75	Aug. 15	5	Aug. 26	40
Sophie	Aug. 6	1	Sept. 12	60	" 26	6	Sept. 9	10
Dabersche	July 24	1	Sept. 5	75	" 15	1	Aug. 26	75
Richter's Imperator	" 24	1	Aug. 28	90	July 23	6	" 26	50
Magnum Bonum	Aug. 6	1	Sept. 12	97	Aug. 26	15	Sept. 9	50
Irene	" 6	0.5	" 12	90	" 26	5	Aug. 26	5
Professor Maerker	" 6	0.5	" 12	97	" 15	1	" 26	10
Silesia	" 6	0.5	" 12	95	" 26	25	" 26	25
Max Eyth	" 6	0.5	" 5	75	" 26	5	" 26	5
Mohort	" 6	0.5	" 12	80	July 23	1	" 26	10
Gastold	" 6	0.5	" 12	97	" 23	1	Sept. 9	35
President Kruger	" 6	1	" 5	95	Aug. 20	5	Aug. 26	15
Professor Wohltmann	" 6	0.5	" 5	50	" 15	1	" 26	12
Topaz	" 6	1	Aug. 28	50	" 15	2	" 31	25
Boncza	" 6	1	Sept. 5	80	" 26	5	Sept. 9	10
Leo	" 6	10	" 5	90	July 23	3	" 9	50
Fuerst Bismarck	" 6	1	" 5	75	Aug. 26	5	Aug. 26	5
Apollo	" 6	2	" 5	50	July 23	1	" 26	5
Gelbfleischige sp. Kartoffel	" 6	1	Aug. 20	40	Aug. 1	10	" 31	50
Eigenheimer	" 6	5	Sept. 5	80	" 26	5	" 31	15
Landskroon	" 6	1	Aug. 28	50	July 23	45	" 1	75
Eureka	" 6	1	Sept. 5	75	" 23	25	Sept. 9	60
Malador	" 20	10	" 5	25	" 23	6	" 9	25
Daisy	" 6	2	" 12	95	" 23	20	Aug. 2	35

TABLE III—CONTINUED

Accession number	Name of variety	1906				1907			
		Date of first appearance	Percent of infection	Date of maximum infection	Percent of infection	Date of first appearance	Percent of infection	Date of maximum infection	
524	Belle de Fontenay	Aug. 6	5	Aug. 13	10	Aug. 15	10	Aug.	20
525	Brandale	" 6	5	" 20	50	" 15	2	"	20
526	Early Rose	July 24	1	" 20	97	July 23	6	"	2
527	Chave (Shaw)	Aug. 6	25	" 20	75	Aug. 2	3	"	31
528	Belle de Juillet	" 4	50	" 7	90	July 23	6	"	15
529	Quarantaine de la Halle.	" 4	2	" 28	97	" 23	3	"	26
531	Ninety-fold	" 4	75	" 7	90	" 23	3	"	15
532	Epicure	" 6	75	" 6	75	" 23	3	"	20
533	Supreme	" 6	20	" 20	60	" 23	3	"	31
534	Windsor Castle	" 6	10	Sept. 5	80	" 23	1	"	31
535	Discovery	" 6	0.5	" 12	60	Aug. 2	5	"	31
536	Sir John Llewellyn	July 24	1	Aug. 6	80	July 23	6	"	15
537	King Edward VII	Aug. 6	10	" 20	90	Aug. 15	1	"	31
538	Cramond Blossom	" 6	5	Sept. 5	90	July 23	1	"	31
539	Charles Fidler	Aug. 6	5	Aug. 28	90	July 23	10	"	31
540	Factor	" 6	2	" 28	75	" 23	1	"	31
541	Duke of York	July 24	1	" 4	50	Aug. 2	50	"	15
542	Langworthy	Aug. 6	10	Sept. 5	90	" 26	5	"	31
543	Tyne Kidney	" 6	10	Aug. 28	90	" 15	2	"	31
544	Table Talk	" 6	5	" 28	90	July 23	1	"	31
545	Dalmeny Kidney	" 6	5	Sept. 5	95	" 23	1	"	31
546	Crofter	" 6	1	" 5	90	" 23	2	Sept.	9
547	Scottish Queen	" 6	0.5	" 5	80	" 23	1	Aug.	31
548	Premier	" 6	1	Aug. 28	90	Aug. 15	1	"	31
549	Northern Star	" 6	2	Sept. 5	97	" 15	1	"	26
550	Pink Blossom	" 6	2	Aug. 28	90	July 23	1	"	26
551	Peace Maker	" 20	20	Sept. 12	97	Aug. 26	1	"	31
552	Dalmeny Red	" 6	1	" 5	97	" 15	1	"	31
553	Dalmeny Early	July 24	1	Aug. 20	90	July 23	1	"	26
554	Sharpe's Epicure	Aug. 6	35	" 20	80	Aug. 2	5	"	26
555	Midlothian Early	July 24	1	" 4	40	July 23	25	"	15
556	Southern Queen	" 24	1	" 28	97	" 23	20	"	31
557	Webber's Early	Aug. 4	10	" 20	95	" 23	4	"	31
558	White Blossom	" 6	2	" 28	80	" 23	3	"	31
559	Red Kidney	" 6	2	" 13	5	Aug. 15	50	"	15
560	Money Maker	" 6	1	" 20	80	July 23	5	"	15
561	Sir Thomas Lipton	" 6	2	" 28	95	" 23	4	"	26
562	Radium	" 6	2	" 28	90	" 23	1	"	31
563	Acme	" 4	5	" 28	95	" 23	1	"	31
564	Heather Blossom	" 6	2	Sept. 5	95	" 23	4	"	26
565	Discovery	" 6	1	" 5	80	" 23	3	"	31
566	Supreme	" 6	20	Aug. 28	90	" 23	2	"	26
567	Ideal	" 6	25	" 20	80	" 23	1	"	5
568	Flour Ball	" 6	1	" 28	95	" 23	1	"	31
569	Ninety-fold	" 4	5	" 20	75	Aug. 5	15	"	15
570	Evergood	" 6	1	" 28	90	" 5	10	"	31
572	Up-to-Date	" 6	2	Sept. 5	97	" 5	12	"	26
573	Northern Star	" 6	1	" 5	95	" 26	5	"	31
574	British Queen	" 4	2	Aug. 28	90	" 5	10	"	31
575	Fidler's Seedling	" 20	25	Sept. 5	75	Dropped from list			
576	Charles Fidler	" 6	5	" 5	97	Aug. 5	30	Aug.	26
577	Snowball	" 6	10	Aug. 20	75	" 5	15	"	31

TABLE III—CONTINUED

Name of variety	1906				1907			
	Date of first appearance	Date of first infection	Date of maximum infection	Percent of infection	Date of first appearance	Percent of infection	Date of maximum infection	Percent of infection
Monarch	Aug. 6	20	Sept. 12	99	Aug. 5	1	Aug. 31	10
Dumfrie's Model	" 6	10	Aug. 28	90	" 5	1	" 31	10
Duchess of Cornwall	" 6	2	Sept. 5	95	" 5	10	" 31	25
Factor	" 6	5	" 5	90	" 5	5	Sept. 14	25
Improved Kidney	" 6	5	" 5	90	" 5	20	Aug. 31	35
King Edward VII	" 20	1	" 12	90	Dropped from list			
Sir John Llewellyn	" 6	75	Aug. 6	75	Aug. 5	50	Aug. 5	50
Cramond Blossom	" 6	0.5	Sept. 12	95	" 5	1	" 26	25
Langworthy	" 6	2	" 12	95	" 5	10	" 31	15
Duke of Rothesay	" 4	5	Aug. 20	99	" 5	30	" 20	75
Royal Kidney	" 6	5	" 20	90	" 5	3	" 31	50
Duke of York	" 4	25	" 20	95	July 23	5	" 15	98
Empress Queen	" 4	10	" 20	50	Aug. 5	20	" 26	30
British Queen	July 24	0.5	" 20	95	" 5	1	" 26	25
Royal Kidney	Aug. 6	2	" 20	90	" 5	1	" 31	50
Empire Kidney	" 6	1	Sept. 12	99	" 6	6	" 31	25
Evergood	" 6	1	" 5	60	" 6	20	" 26	35
Goodfellow	" 6	5	" 12	95	" 6	10	" 26	30
Up-to-Date	" 4	5	" 5	90	July 23	1	" 26	25
Northern Star	" 6	2	" 5	90	Aug. 15	1	" 26	15
Eldorado	" 6	1	" 5	80	July 23	3	" 31	60
American Wonder	" 4	10	Aug. 20	99	Aug. 6	30	" 31	90
Boss	" 4	2	" 28	99	July 23	6	" 26	70
Buffalo	" 4	5	" 28	95	" 23	1	" 31	50
Cambridge Russet	" 4	5	" 28	95	Aug. 6	3	Sept. 9	70
Clarke's Pride	July 24	1	" 13	98	July 23	10	Aug. 20	90
Crine's Lightning	Aug. 4	2	" 28	97	" 23	6	" 31	50
Dakota Red	" 6	2	Sept. 5	90	Aug. 5	5	Sept. 9	60
Delaware	" 6	5	Aug. 28	95	July 23	3	" 9	75
Doe's Pride	" 6	1	" 28	97	" 23	3	Aug. 31	60
Enormous	" 4	5	" 28	95	" 23	3	" 26	40
Gem of Aroostook	" 4	10	" 20	80	" 23	10	Sept. 9	90
Blight Proof	" 4	2	Sept. 5	95	Aug. 15	2	" 9	50
Green Mountain	" 4	5	Aug. 28	95	July 23	1	" 9	65
Harris Snowball	July 24	5	Sept. 5	97	" 23	6	Aug. 31	40
Holborn Abundance	Aug. 4	10	" 5	100	" 23	6	" 31	50
Onia Seedling	" 4	5	" 12	99	" 23	3	Sept. 9	40
Irish Cobbler	" 4	50	" 8	75	" 23	3	Aug. 20	75
Keeper	" 6	0.5	Aug. 28	95	" 23	3	" 31	40
Late Blightless	" 6	0.5	Sept. 5	60	Aug. 26	1	Sept. 21	20
Norcross	" 4	10	Aug. 28	95	July 23	3	Sept. 9	80
Million Dollar	Aug. 4	0.5	Aug. 28	95	Aug. 6	6	Sept. 9	50
Norcross	" 4	0.5	" 28	97	July 23	3	" 9	60
Orange Blossom	" 6	3	Sept. 12	95	Aug. 15	2	" 9	35
Quick Lunch	July 24	1	Aug. 8	98	July 23	10	Aug. 15	85
Rural New Yorker No. 2.	" 24	1	" 8	90	Aug. 6	40	" 20	75
Scab Proof	Aug. 4	10	" 28	90	" 6	1	" 31	40
Sir Walter Raleigh	" 4	5	" 28	95	" 6	1	Sept. 9	75
Star-of-the-East	" 4	20	" 28	95	" 6	10	Aug. 31	45
State of Maine	" 4	5	" 28	90	" 20	5	Sept. 9	75
Swiss Snowflake	" 4	5	" 28	95	" 6	1	" 9	40
Gold Coin	" 4	5	" 28	97	July 23	1	" 9	80

TABLE III—CONTINUED

Accession number	Name of variety	1906				1907			
		Date of first appearance	Percent of infection	Date of maximum infection	Percent of infection	Date of first appearance	Percent of infection	Date of maximum infection	
630	Westfield	Aug. 4	5	Aug. 28	90	Aug. 15	2	Sept.	1
631	White Beauty	July 24	1	" 28	97	" 15	2	"	9
632	White Scotch King	" 24	1	" 28	97	" 6	5	Aug.	31
633	Unnamed Pink	Aug. 4	5	" 28	95	Aug. 6	6	Sept.	9
634	Babbitt	" 4	10	" 20	50	" 6	1	"	5
635	Unknown variety	" 4	10	" 28	97	" 6	1	"	5
636	*Solanum Commersoni*	Sept. 5	10	Sept. 12	75	" 8	1	"	9
637	Alexander's No. 1 red	Aug. 6	5	" 12	90	" 8	1	"	9
638	Washington	" 4	10	Aug. 28	97	" 8	1	"	9
639	Orlando	" 4	10	Sept. 5	95	July 23	1	Aug.	31
640	Alexander's No. 10	" 4	10	Aug. 28	97	" 23	1	"	31
641	Gem	July 24	1	" 28	90	Aug. 8	2	Sept.	9
642	Pasadena	" 24	1	" 20	50	" 8	4	"	9
643	Alexander's No. 50	Aug. 4	5	" 28	95	" 8	5	Aug.	31
644	Alexander's No. 100	" 4	1	" 28	90	July 23	1	Sept.	9
645	Havana	" 4	1	" 28	97	" 23	10	"	9
646	Reliance (Maule's)	" 6	10	" 28	75	Aug. 8	1	Aug.	31
647	Sunset	July 24	1	" 20	95	" 8	12	"	31
648	Alexander's No. 4	" 24	1	" 20	95	" 8	1	"	31
649	Alexander's No. 7	Aug. 4	10	" 28	97	" 8	10	"	31
650	Alexander's Seedling	" 4	5	" 28	90	" 8	5	"	31
651	Alexander's Seedling	" 4	5	" 20	95	" 15	10	"	31
652	Professor Maerker	" 6	1	Sept. 12	99	" 26	1	"	26
653	Rural Blush	" 8	2	" 5	90	" 8	1	"	31

The lesson to be drawn from this table is that in order to secure benefit from spraying potatoes for early blight in Vermont, the first application should be made early in July. The exact date will of course be governed by the date of planting and the variety grown.

The following conclusions seem warranted:

1. That the varieties showing the greatest resistance or freedom from early blight are, with few exceptions, of foreign origin, the exception being American varieties without commercial value.

2. That the resistant foreign varieties almost without exception have no value for commercial purposes, being usually light yielders and rather poor in quality.

3. That the value of the disease resistant varieties is problematical rather than actual. The plant breeder, by mating them with the most desirable commercial American types, may develop commercial types of resistant varieties.

2. TUBER RESISTANCE TO SCAB

From time to time claims are made by seedsmen that the tubers of the variety which they seek to introduce or which they have on sale, are resistant to scab. In order to determine to what extent such claims may be considered valid, a careful study was made of a considerable number of varieties, among which were included several so-called scab-resistant types. Sixty-five varieties were planted in 1906 and 20 in 1907 on land known to be thoroughly infested with the scab organism.

The tubers of each hill were carefully examined at harvest to determine whether in any case the whole product of a single plant was entirely free from scab infection. In not a single instance was this found to be true; but, as might be expected, many were found which showed only a few scab spots on a tuber or two. In such instances it was assumed that the relative degree of infection as between given plants of a variety was more largely a matter of soil infection than of the inherent resistant character in the plant itself. This assumption was substantiated in 1907, when the few hill selections that were made from the 1906 crop showed no greater resistance to scab than did the regular seed stock. These data are not presented as they are not thought to be of sufficient importance to justify publication.

1906 trials. Sixty-five varieties were grown on soil well inoculated with the scab organism. Considerable divergencies were observed in the amount of scab on the different varieties at harvest, and careful laboratory notes were taken, the tubers being separated into four lots; those entirely free, those showing scattering spots, those which were from one-third to two-thirds scabby and those which were scabby to the extent of two-thirds or more of their surface. The proportion of scab in each case was determined by observation and not by accurate measurement and is not a strictly correct statement. However, the fact that the same person made all the observation at least makes the results relative and comparable.

The data presented in table IV show the percentage of tubers falling into each of the above classes. Every tuber harvested was examined and its scabbiness estimated.

TABLE IV—PERCENT OF TUBERS FREE FROM SCAB; SLIGHTLY SCABBY; ONE-THIRD TO TWO-THIRDS SCABBY; TWO-THIRDS TO WHOLLY SCABBY; SEASON OF 1906

Accession number	Name of variety	Percent free	Percent slightly scabby	Percent ⅓ to ⅔ scabby	Percent ⅔ to wholly scabby	Percent free or nearly free from scab
503	Richter's Imperator	3.2	23.1	23.4	50.3	26.3
504	Magnum Bonum	0.9	28.5	24.3	46.3	29.4
505	Irene	8.8	41.9	18.4	30.9	50.7
506	Professor Maerker	9.8	24.1	24.1	42.	33.9
509	Mohort	3.5	28.1	32.7	35.7	31.6
512	Professor Wohltmann ..	15.5	48.8	22.9	12.8	64.3
513	Topaz	1.5	48.7	27.6	22.2	50.2
514	Boncza	14.1	71.8	8.9	5.2	85.9
516	Fuerst Bismarck	10.4	66.1	14.5	9.0	76.5
517	Apollo	7.5	25.4	25.4	41.7	32.9
521	Eureka	17.4	43.9	26.5	12.2	61.3
531	Ninety-fold	15.5	49.8	21.9	12.8	65.3
532	Epicure	1.0	16.6	33.9	48.5	17.6
533	Supreme	3.3	26.1	26.8	43.8	29.4
534	Windsor Castle	9.3	42.2	30.1	18.4	51.5
535	Discovery	14.8	52.3	22.8	10.1	67.1
536	Sir John Llewellyn	9.7	64.1	17.5	8.7	73.8
537	King Edward VII.....	6.8	44.0	33.7	15.5	50.8
538	Cramond Blossom	6.9	29.6	33.7	29.8	36.5
539	Charles Fidler	16.2	27.0	25.4	31.4	43.2
540	Factor	3.5	14.3	25.8	56.4	17.8
541	Duke of York	7.6	16.0	36.5	39.9	23.6
542	Langworthy	4.2	17.8	22.7	55.3	22.0
543	Tyne Kidney	3.9	15.5	28.9	51.7	19.4
544	Table Talk	6.0	26.4	31.3	36.3	32.4
545	Dalmeny Kidney	12.2	34.8	24.7	28.3	47.0
546	Crofter	2.0	16.7	24.4	56.9	18.7
547	Scottish Queen	8.3	19.8	27.3	44.6	28.1
548	Premier	11.8	13.7	18.6	55.9	25.5
551	Peace Maker	8.0	24.8	34.4	32.8	32.8
552	Dalmeny Red	1.7	12.5	30.1	55.7	14.2
557	Webber's Early	5.4	19.0	30.4	45.2	24.4
559	Red Kidney	8.5	15.4	21.6	54.5	23.9
560	Money Maker	23.2	46.1	19.7	11.0	69.3
561	Sir Thomas Lipton	21.8	47.4	21.3	9.5	69.2
562	Radium	10.0	50.4	26.5	13.1	60.4
566	Supreme	1.0	7.6	31.8	59.6	8.6
568	Flourball	1.9	12.4	32.0	53.7	14.3
570	Evergood	13.3	47.1	20.9	18.7	60.4
572	Up-to-Date	1.8	8.4	11.4	78.4	10.2
573	Northern Star	3.3	11.3	13.7	71.7	14.6
574	British Queen	2.7	18.1	16.7	62.5	20.8
576	Charles Fidler	5.2	36.4	32.5	25.9	41.6
578	Monarch	12.9	29.2	23.6	34.3	42.1
579	Dumfrie's Model	15.4	37.5	27.8	19.3	52.9
580	Duchess of Cornwall...	17.2	56.9	16.0	9.9	74.1
581	Factor	14.5	39.1	32.6	13.8	53.6
585	Cramond Blossom	5.3	17.7	29.6	47.4	23.0
586	Langworthy	4.5	31.8	28.4	35.3	36.3
587	Duke of Rothesay	...	...	30.8	69.2	0.
588	Royal Kidney	7.7	19.7	24.9	47.7	27.4
589	Duke of York	6.9	27.9	32.3	32.9	34.8

TABLE IV—CONTINUED

Accession number	Name of variety	Percent free	Percent slightly scabby	Percent ⅛ to ⅜ scabby	Percent ⅜ to wholly scabby	Percent free or nearly free from scab
590	Empress Queen	9.2	38.4	32.4	20.0	47.6
591	British Queen	12.9	39.7	28.3	19.1	52.6
593	Empire Kidney	7.2	28.7	36.3	27.8	35.9
594	Evergood	18.7	57.1	16.1	8.1	75.8
595	Goodfellow	11.4	42.0	26.1	20.5	53.4
597	Northern Star	11.9	43.8	28.9	15.4	55.7
598	Eldorado	17.2	46.8	28.1	7.9	64.0
599	American Wonder	0.9	12.3	47.2	39.6	13.2
602	Cambridge Russet	17.1	41.0	24.3	17.6	58.1
603	Clarke's Pride	3.8	25.1	30.8	40.3	28.9
610	Blight Proof	8.5	39.0	39.4	13.1	47.5
613	Holborn Abundance	13.3	44.6	31.1	11.0	57.9
619	Million Dollar	19.4	60.4	20.2	...	79.8
621	Orange Blossom	9.2	37.4	33.9	19.5	46.6
626	Star-of-the-East	9.2	35.3	43.1	12.4	44.5
628	Swiss Snowflake	6.8	22.4	45.5	25.3	29.2
630	Westfield	3.7	28.7	41.9	25.7	32.4
631	White Beauty	...	8.6	39.1	52.3	8.6
632	White Scotch King ...	3.2	32.3	45.4	19.1	35.5
633	Unnamed Pink	4.5	20.7	44.7	30.1	25.2
634	Babbitt	1.9	27.0	49.5	21.6	28.9
637	Alexander's No. 1 Red.	5.8	34.7	42.6	16.9	40.5

The fifth column of figures in this table displays the percentage of tubers free or almost wholly free from scab. It is believed that this figure is perhaps a safer index to the relative scab resistance of a variety than is that of the scab-free tubers alone. Table V facilitates such a comparison. The 25 varieties showing the largest percentage of tubers free from scab are arranged therein in the order of their freedom, while in a parallel column are arranged 25 varieties showing the highest percentage of tubers having little or no scab.

TABLE V—TWENTY-FIVE NUMBERS, 1906

Varieties showing greatest percent of tubers free from scab			Varieties showing greatest percent of tubers free or nearly free from scab		
Accession number	Name of variety	Percent free	Accession number	Name of variety	Percent free or nearly free
560	Money Maker	23.2	514	Boncza	85.9
561	Sir Thomas Lipton	21.8	619	Million Dollar	79.8
619	Million Dollar	19.4	516	Fuerst Bismarck	76.5
594	Evergood	18.7	594	Evergood	75.8
621	Eureka	17.4	580	Duchess of Cromwell	74.1
580	Duchess of Cromwell	17.2	536	Sir John Llewellyn	73.8
598	Eldorado	17.2	560	Money Maker	69.3
602	Cambridge Russet	17.1	561	Sir Thomas Lipton	69.2
539	Charles Fidler	16.2	535	Discovery	67.1
531	Ninety-fold	15.5	531	Ninety-fold	65.3
512	Prof. Wohltmann	15.5	512	Prof. Wohltmann	64.3
579	Dumfrie's Model	15.4	598	Eldorado	64.0
535	Discovery	14.8	521	Eureka	61.3
581	Factor	14.5	562	Radium	60.4
514	Boncza	14.1	570	Evergood	60.4
570	Evergood	13.3	602	Cambridge Russet	58.1
613	Holborn Abundance	13.3	613	Holborn Abundance	57.9
578	Monarch	12.9	597	Northern Star	55.7
591	British Queen	12.9	581	Factor	53.6
545	Dalmeny Kidney	12.2	595	Goodfellow	53.4
597	Northern Star	11.9	579	Dumfrie's Model	52.9
548	Premier	11.8	591	British Queen	52.6
595	Goodfellow	11.4	534	Windsor Castle	51.5
516	Fuerst Bismarck	10.4	537	King Edward VII	50.8
562	Radium	10.0	505	Irene	50.7

Only 4 varieties—Charles Fidler, Monarch, Dalmeny Kidney and Premier—appearing in the first list are not found in the second. The varieties which supplanted them—Dumfries Model, Windsor Castle, King Edward VII and Irene—are at the foot of the second list. In the main, therefore, the ranking varieties in one list stand high in the other.

1907 trials. Twenty of the 65 varieties tested in 1906 were grown in 1907 on the same plot of ground as in the previous year, but no attempt was made to plant them in the identical positions used in 1906.

TABLE VI—AVERAGE PERCENT OF TUBERS FREE FROM SCAB; SLIGHLY SCABBY; ONE-THIRD TO TWO-THIRDS SCABBY; AND TWO-THIRDS TO WHOLLY SCABBY; SEASON OF 1907

Accession number	Name of variety	Percent free	Percent slightly scabby	Percent ⅓ to ⅔ scabby	Percent ⅔ to wholly scabby	Percent free or nearly free from scab
512	Professor Wohltmann ..	0.4	35.7	32.2	31.7	36.1
514	Boncza	1.9	60.6	31.7	5.8	62.5
516	Fuerst Bismarck	7.4	38.8	32.8	21.0	46.2
521	Eureka	9.5	33.3	24.5	32.7	42.8
531	Ninety-fold	4.1	50.4	39.1	6.4	54.5
535	Discovery	2.5	30.9	35.1	32.5	33.4
536	Sir John Llewellyn	8.4	38.9	34.2	18.5	47.3
539	Charles Fidler	0.5	28.6	39.5	31.4	29.1
560	Money Maker	0.4	34.4	43.3	21.9	34.8
561	Sir Thomas Lipton....	0	25.0	35.1	39.9	25.0
579	Dumfrie's Model	0	18.9	29.2	51.9	18.9
580	Duchess of Cornwall...	0	13.4	28.7	57.9	13.4
581	Factor	0	9.0	32.1	58.9	9.0
594	Evergood	0	17.5	29.3	53.2	17.5
598	Eldorado	0	15.6	22.1	62.3	15.6
602	Cambridge Russet	0	9.6	41.6	48.8	9.6
610	Blight Proof	0	11.3	30.0	58.7	11.3
613	Holborn Abundance....	0	8.4	27.6	64.0	8.4
619	Million Dollar	0	38.7	32.8	28.5	38.7
626	Star-of-the-East	0	9.8	31.5	58.7	9.8

The outcome in 1907 is quite unlike that obtained in 1906. A larger percentage of the tubers was seriously infested with scab, indicating, and substantiating previous observations and recommendations, that to follow potatoes with potatoes on the same land is an undesirable practice, particularly when the soil is infested with scab. In no case was there found 10 percent of scab-free tubers of any variety. Only two varieties—Boncza (German) and Ninety-fold (English)—were found to yield over 50 percent of nearly scab-free tubers.

Table VII permits one to make a close study of the two years' results. The percentages of scab-free and of nearly scab-free tubers are tabulated in parallel columns, the varieties being arranged in the order of the combined percentages of tubers free, or nearly free, from scab as shown in table VI.

TABLE VII—A COMPARISON OF 1906 AND 1907 SHOWING RELATIVE SCAB RESISTANCE

Accession number	Name of variety	1906		1907		Average 1906 and 1907 of tubers free or nearly free from scab
		Percent free from scab	Percent free or nearly free from scab	Percent free from scab	Percent free or nearly free from scab	
514	Boncza .....(German)	14.1	85.9	1.9	62.5	74.2
619	Million Dollar .....(American)	19.4	79.8	0.	38.7	59.3
516	Fuerst Bismarck ....(German)	10.4	76.5	7.4	46.2	61.4
594	Evergood .....(English)	18.7	75.8	0.	17.5	46.7
580	Duches of Cromwell.(English)	17.2	74.1	0.	13.4	43.8
536	Sir John Llewellyn..(English)	9.7	73.8	8.4	47.3	60.6
560	Money Maker .....(English)	23.2	69.3	0.4	34.8	52.1
561	Sir Thomas Lipton...(English)	21.8	69.2	0.	25.0	47.1
535	Discovery .....(English)	14.8	67.1	2.5	33.4	50.3
531	Ninety-fold .....(English)	15.5	65.3	4.1	54.5	59.9
512	Prof. Wohltmann ....(German)	15.5	64.3	0.4	36.1	50.2
598	Eldorado .....(Scotch)	17.2	64.0	0.	15.6	39.8
521	Eureka .....(Dutch)	17.4	61.3	9.5	42.8	52.1
602	Cambridge Russet...(American)	17.1	58.1	0.	9.6	33.9
613	Holborn Abundance..(American)	13.3	57.9	0.	8.4	33.2
581	Factor .....(English)	14.5	53.6	0.	9.0	31.3
579	Dumfrie's Model ....(English)	15.4	52.9	0.	18.9	35.9
610	Blight Proof .....(American)	8.5	47.5	0.	11.3	29.4
626	Star-of-the-East .....(American)	9.2	44.5	0.	9.8	27.2
539	Charles Fidler .....(English)	16.2	43.2	0.5	29.1	36.2

The German variety Boncza leads both seasons. The ratios of resistance were much lower in 1907 than in 1906, indicating the increased severity of infection. Million Dollar (American) stands second in 1906 and sixth in 1907; Sir John Llewllyn (English) sixth and third; Ninety-fold (English) tenth and second; Fuerst Bismarck (German) third and fourth.

The apparent lack of correlation between the results attained with some of the varieties during the two seasons would seem to suggest the possibility of such disturbing factors as unequal soil infection, varying positions in the field, differences in soil moisture, etc. It raises the pertinent question whether the comparative freedom from scab observed in some cases may not have been due largely to the accident of position. Yet on the other hand, certain results (Boncza and Fuerst Bismarck, for instance) would seem to be beyond the chance of accident.

The data presented are too meagre to justify definite and clear-cut assertions. Yet the following statements seem permissible:

1. That none of the varieties tested showed strongly marked scab resistant qualities when grown on soil well infested with scab organisms.

FIGURES 1 AND 2—Green Mountain (611). Million Dollar (619). Gold Coin (629).
Three desirable American types.

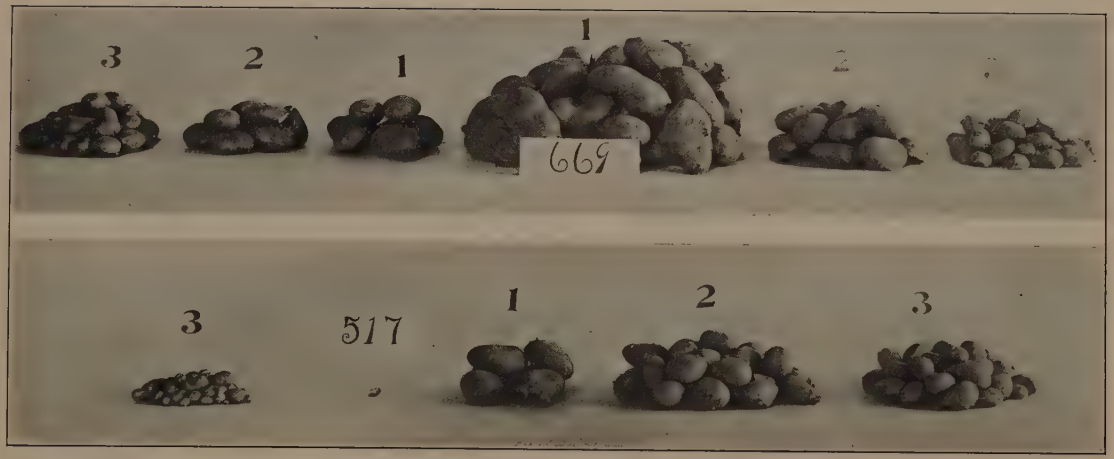
Factor (540). Langworthy (542). Northern Star (597).
Three desirable English and Scotch types.

FIGURES 3 AND 4—Dakota Red (605). Alexander's No. 1 Red (637). Blight Proof (610). Manly (669). Lawrence Seedling No. 2 (4229). Five undesirable American types.

Mohort (509). Cambridge Russet (602) [French fried]. Leo (515). Rand's Peach Blow (705) [Boiling]. Langworthy (542). Norcross (618) [Baking]. Three cooking types.

FIGURES 5 AND 6—Sophie (501). Professor Wohltmann (512). Apollo (517). Three disease resistant German varieties.

Manly (669). Sprayed hill (left), unsprayed hill (right), September 9, 1908.



FIGURES 7 AND 8—Manly (669). Crop from unsprayed hill (left), and sprayed hill (right). Apollo (517). Crop from unsprayed hill (left), and sprayed hill (right).

1. Tubers 3 ounces in weight and over. 2. 1½ to 3 ounces. 3. Under 1½ ounces.

2. That the notion commonly prevalent to the effect that a russet skinned variety does not become scabby is not based on fact, as evidenced by the behavior of Cambridge Russet which occupies fourteenth position in 1906 and eighteenth in 1907. Personal observation during the past 6 years corroborates this statement.

3. That some varieties are apparently somewhat less subject to scab than are others (Boncza and others); but whether this immunity is wholly or only partially inherent cannot be determined from the data now in hand.

4. That there seems to be little hope of securing scab-resistant varieties through selection.

3. THE GROWING OF SEEDLING POTATOES

The growing of seedling potatoes has been a somewhat important feature of the experimental work carried out in connection with the studies on varietal disease resistance. This was begun in a small way in 1904 and continued until 1909 when the writer's direct connection with the Station ceased. Little or no success was met in securing artificial crosses, either between varieties or within the varieties themselves until 1909. Most of the seedlings which were grown during the period mentioned were produced from naturally fertilized seed. The seeds resulting from the 1909 crosses were by permission transferred to the writer when he entered the employ of the United States Department of Agriculture and were grown by him in 1910. The results attained will be embodied in a publication soon to be issued by the Department.

Saving the seed. The seedballs should be allowed to remain on the plants until they are fully matured, or, in the case of late maturing varieties, until danger of frost injury, when they should be gathered and stored in a fairly warm room, there to remain until they are fully ripe, in which condition the seeds are most easily removed from the pulpy flesh in which they are embedded. The seeds are readily removed and cleansed by crushing each individual seedball into a pulpy mass and dropping it into a vessel of water. A few days soaking in water develops considerable fermentation, which serves to break down the cell structure of the pulp and thus to release the seeds. Frequent stirrings of the mass assist in the separation. When most of the seeds have parted from the pulp, water is poured or run slowly into the vessel, and at the same time the mass is gently stirred. This procedure is continued until the pulp and skin of the

berries have been floated off, after which the water contained in the vessel is strained through a piece of finely woven chesecloth. The seeds are then spread out to dry and, later, put away for the same or a subsequent season's planting. Their vitality is not impaired under good storage conditions for several years.

Sowing the seed. Experience has shown that the best time to sow the seed under Vermont conditions is from April 1 to 10. Sown at this time, seedlings can be obtained which will be ready to set in the open ground from 4-inch pots by June 1, or earlier if desired. By this date all danger from late frosts are avoided and the soil and outside temperature are warm enough to favor rapid growth.

As handled in the station greenhouse, the seeds were sown in seedpans or flats in a light, friable soil and placed in a room with a night temperature of 60° F. and a day temperature of 75° F. Under these conditions, if the seeds are plump and well ripened, some germination will be noticed in a week, and in two weeks a considerable proportion of the seed will have germinated. As soon as they are well started or have developed the first true leaf, they are ready to be potted or pricked off into flats. In almost every instance the seedlings were potted into 2½-inch pots and transferred when well rooted to 4-inch pots. With the first transplanting they may be placed in a room with a night temperature of 55° F. and a 10° to 15° rise during the day. When transferred to the larger pots, the temperature may be reduced another 5 degrees. Handled in this way, the plants make a slow, stocky growth. Ten days prior to setting in the field the night temperature may be still further reduced, or they may be transferred to the cold frame to harden up. When thus treated there is practically no shock to the plant when set in the field.

Distance. A distance of 3 x 3 feet is none to great for well grown plants. Indeed in many instances the vine growth of some of the seedlings has occupied much more than this space.

Size of tubers from the first year seedlings. In most of the articles on seedling potato growing which have come to the writer's attention, the grower expressed his satisfaction with the first year's results if he secured tubers of the size of a hen's egg. Apparently it has not occurred to some of these growers that full-grown tubers can be produced from seed in a single season's growth. The largest yield secured by the writer from a seedling plant during 6 years' experience is slightly in excess of 9 pounds. In many instances tubers were produced weighing from one-half to one pound each. On the

other hand, under exactly the same conditions of culture, plants produced from seeds of the same seedball gave yields of less than half an ounce and from that up to several pounds.

A similar wide variation was observed in the color of the tubers, which ranged from a glistening white to a bluish black. Equally marked differences occurred in the form of the tuber and in the depth, number, and arrangement of the eyes. The plants varied in vine growth from those with wide spreading, vigorous stems, sometimes 6 feet in diameter, to those which scarcely had vigor enough to produce a single weakly stem. Some matured early, while others did not reach maturity before frost overtook them.

Note taking. The characters of each plant were carefully noted while growth was still active, and each was given a number by which it could be associated at harvest time with the previously recorded observations. Such records, of course, were only feasible where relatively small numbers were grown, say from 1,000 to 2,000 plants. With this data at hand and the products of the plant before one, it became a relatively easy task judiciously to select such as most nearly met the observer's ideal as regards vine and tuber characters. The selected tubers were then described and, after receiving a field number, were added to the general collection for further trial. Necessarily the mortality among seedlings is large. Out of about 1,000 seedlings grown in 1904, 50 were selected for further trial; and of this number, none now remain. Out of an average of from 500 to 1,500 seedlings grown during the years 1904 to 1909, not over a half dozen now remain; and these are beginning to show undesirable qualities, either of vigor or yield. Truly it may be said of this work that progress, if perchance there be any, must needs be slow, that disappointment is certain, and that the percentage of really desirable varities secured will be infinitesimally small.

Real and abiding progress in the growing of seedling potatoes can be secured only through careful hybridization of varieties showing marked superiority in certain directions, such as disease resistance of vine or tuber, or both; resistance to heat, to drouth, to cold, to unfavorable moisture conditions; productiveness, quality or shape; in fact any quality or character that seems an improvement over existing types. Hybridization must be followed by the exercise of intelligent and careful selection of seedlings, if the best results are to be secured.

One of the greatest obstacles in the way of the potato breeder is the relative difficulty experienced in securing a cross between two desirable varieties. Indeed it frequently happens that neither produce viable pollen, and then, of course, seed cannot be obtained. As a rule the varieties which most freely produce viable pollen display certain qualities which make them undesirable for breeding purposes To be consistently successful in potato breeding, one must possess an intimate knowledge of the good and bad characteristics of the varieties with which he is dealing, and, above all, must be located in a section of country where the climatic conditions are favorable to the growth of the plants during the whole period in which the flower buds are developing. Such conditions do not always prevail in Vermont, at least not in the vicinity of Burlington; they do prevail to a marked degree in northern Maine.

4. Desirable Types of Potatoes

The many types of potatoes in cultivation at the present time would seem to indicate that no very rigid standard of excellence is adhered to by potato seedsmen in the introduction of new varieties. Heretofore the qualifications of a new variety seems to have been that it possess some one or more of the following attributes: A fairly vigorous vine growth; early, medium, or late maturity; attractive skin color of tuber; productiveness; and fair quality. Many introductions have been distinctly lacking in the latter respect. As a rule the shape of the tubers is desirable, but there are still too many varieties introduced which produce a nondescript lot of tubers of all shapes and sizes. Apparently such varieties have not been standardized through the selection of a dominant type.

Within the past few years other demands have presented themselves which seem to be of equal importance to those already mentioned; demands for types which shall be more resistant to disease, drouth, heat and cold. These additional factors should be taken into consideration when judging the merits of a new variety.

The question may well be asked: what attributes should be considered essential to a variety to make it worthy of introduction? From the consumer's standpoint, the tubers should be regular in shape; of medium size; when boiled or baked the flesh should be mealy, but not excessively so, white and of good quality. From the grower's standpoint, a good variety should possess a reasonably vigorous and upright habit of growth; abundant foliage, with medium

sized firm leaves, rather than flaccid ones; the tubers should be compact in the hill, forming near the surface, though not too shallow, of medium size, and number (eight to twelve) with relatively few small ones, of good shape and color, eyes rather few and shallow with strong bud cluster; and sufficiently prolific to produce a profitable crop. As a rule, and with most markets, white skinned varieties are preferred to those having a pinkish or reddish tinge. A colored skin is less objectionable in early varieties.

With respect to the shape of the tuber, a wide difference of opinion obtains. In general the kidney, oval and pebble shaped types are preferred to the elongated cylindrical or oblong tubers.

In the accompanying illustrations an attempt has been made to present certain types of desirable and undesirable tubers. It is hoped that these may prove helpful to those contemplating the growing of potatoes either for home use or for commercial purposes. The varieties which have been selected to represent these types were chosen simply to illustrate the particular shapes the writer had in mind rather than to advocate any one variety. In the selection of round tubers for boiling, kidney, oval or pebble shaped tubers for baking, and cylindrical tubers for use as French fried potatoes, it does not follow that the kidney or cylindrical formed tubers could not be used for boiling, or that the cylindrical shapes could not be used for purposes of baking; but it is evident that a round potato is not as well adapted for baking or for French fried potatoes as are either of the other two forms. Advantage is now being taken of this method of grading potatoes by some advanced and progressive growers. It requires but little imagination to predict that in the near future we will have many communities of growers cooperating in the marketing of their crop and adopting rigid rules of grading by which certain classes of stock will be furnished to a discriminating trade.

5. VARIETAL RESPONSE TO BORDEAUX SPRAYING IN THE ABSENCE OF BLIGHT

In order to determine as nearly as possible under good growing conditions the normal ripening period of certain varieties of potatoes under test in the experimental plot, a portion of the plants were sprayed with bordeaux mixture during the seasons of 1906, 1907 and 1908. In 1906 the vines were sprayed on August 9 and September 6; in 1907 on July 11, August 2 and September 7; in 1908 on July 20, 29, August 7 and 19, and September 8. The 1906 spray-

ings were made more for the purpose of protection against the late than the early blight. The earlier application in 1907 was made with a view of controlling the early blight, but was not as effective as desired; hence in 1908 the plants were sprayed five times. A strong barrel force pump was used carrying two leads of hose supplied with either Bordeaux or large Mistry spray nozzles, both of which deliver a large volume of spray mixture. The nozzle operators were instructed to cover the foliage of each plant thoroughly, and the pump man to maintain a high pressure. Consequently the plants were much more effectively protected by a few sprayings than than they would have been by more frequent applications using a mechanically operated spray machine, carrying one or two nozzles per row.

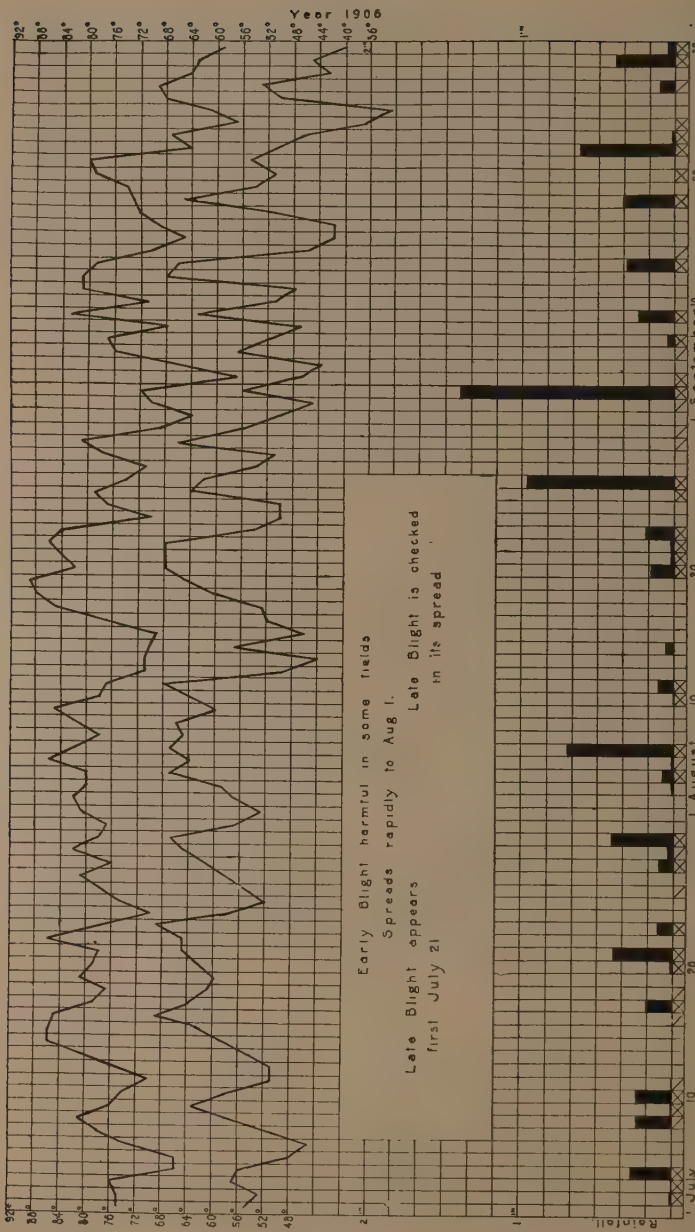
The effect of the spraying upon the yield, even in the absence of late blight, was sufficiently noticeable in 1906, particularly in the proportion of marketable tubers, to suggest the desirability of further work. The 1907 yields from the sprayed plants showed a much more marked increase than in 1906; and in 1908 the yield of merchantable sized tubers on the sprayed as compared with the unsprayed plots was almost five times as great and the total yield was nearly trebled.

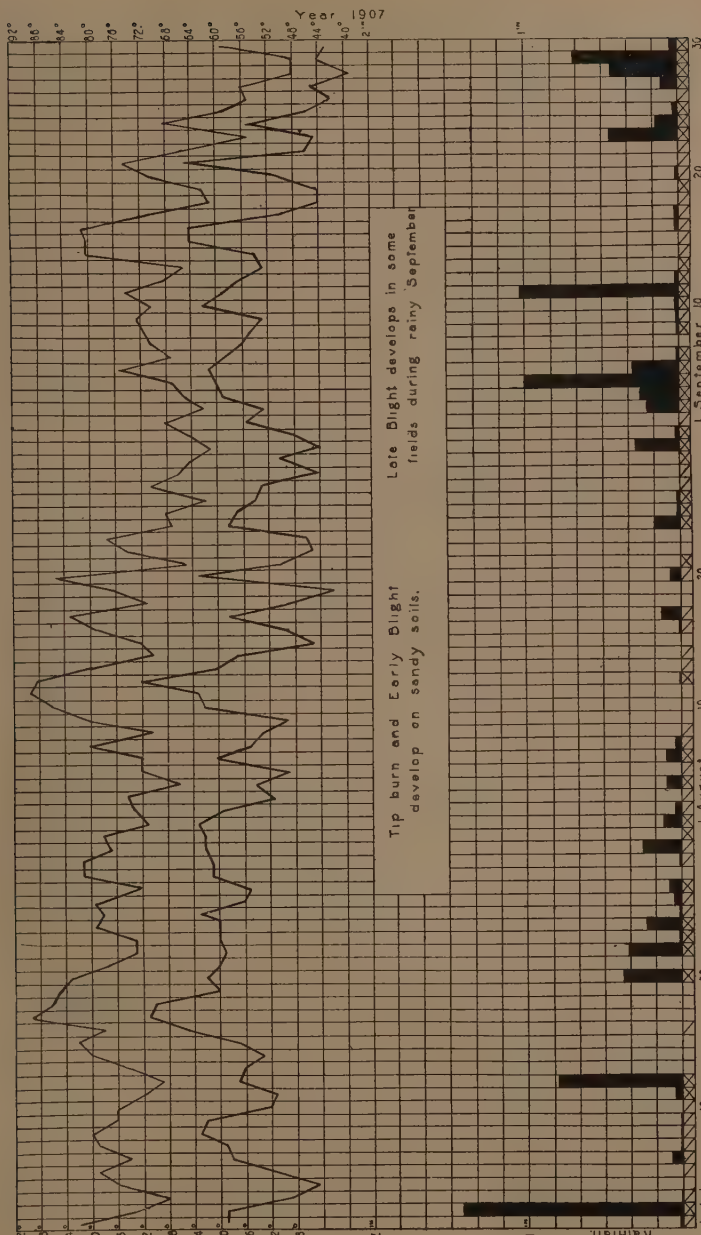
The following data present concisely the average yields from the sprayed and unsprayed plants of 133 varieties grown during 1906 and 1907, and of 50 varieties grown in 1908:

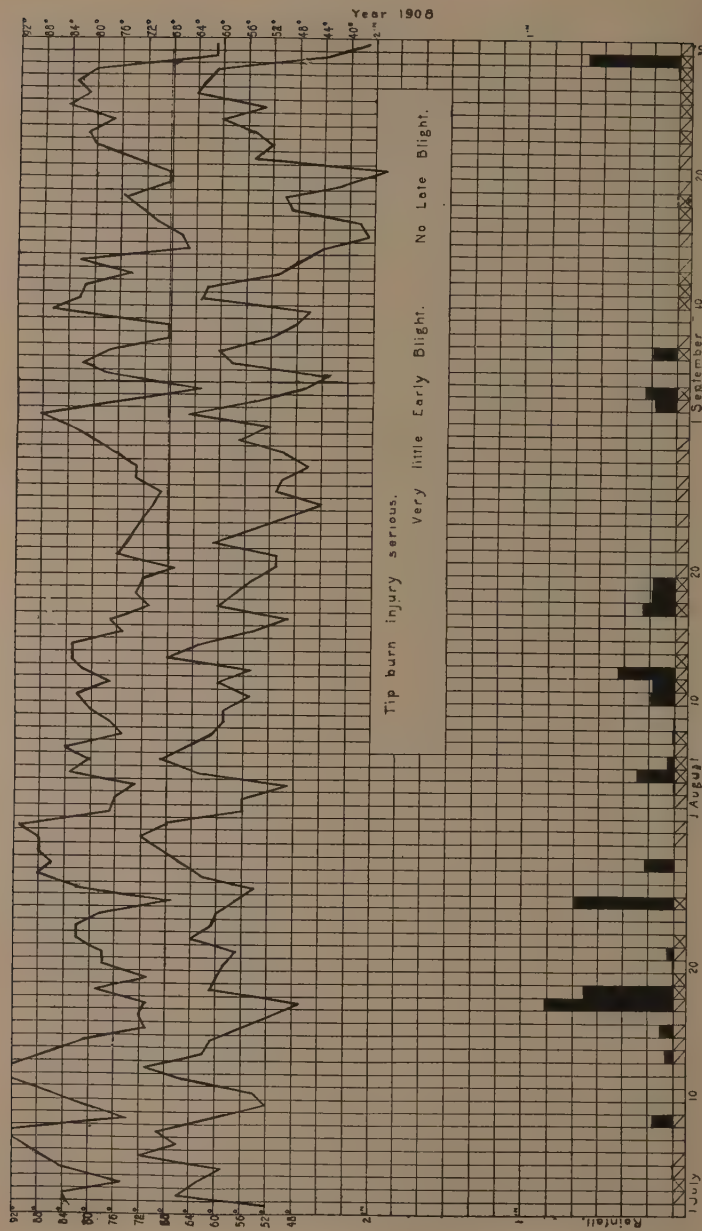
	Times sprayed		Sprayed bushels	Unsprayed bushels	Increase %
1906	Twice	Primes	70.	52.	34.6
		Culls	63.1	62.2	...
		Total	133.1	114.2	16.5
1907	Thrice	Primes	138.6	75.4	83.2
		Culls	93.3	99.9	...
		Total	231.9	175.3	32.3
1908	Five times	Primes	91.6	19.4	372.3
		Culls	51.9	31.0	....
		Total	143.5	50.4	184.7
Averages 1906-1908		Primes	100.1	48.9	104.7
		Culls	69.4	64.4	.....
		Total	169.5	113.3	49.6

In explanation of the pronounced results attained in 1908 it should be stated that the 133 varieties grown in 1906 and 1907 included early as well as medium and late maturing, whereas the 50 grown in 1908 included only medium and late maturing varieties. On the other hand early blight infection was relatively much less severe than in 1906 and 1907; hence the beneficial effects accruing from the reduction of leaf diseases by bordeaux applications should have resulted in a more marked increase from the 1906 and 1907 sprayed plants. It is hardly possible that the additional sprayings in 1908 could account for all of the increase derived from the sprayed plants. It is believed that another explanation may be offered which would seem to throw new light upon the reasons for the striking results secured.

In the accompanying weather charts for 1906, 1907 and 1908, reprinted from bulletin 159, it appears that in 1906 the temperature in July, August and Sptember was not excessively high. The rainfall from August 6th to the 26th was light. During this period, however, there was much cloudy weather, which no doubt materially reduced the injury which might have been occasioned with bright sunshiny days. In 1907 the rainfall from July 31 to August 29 was relatively light and save from August 9 to 13, the temperature was not abnormally high. Abundant rainfall in early September afforded good moisture conditions throughout the rest of the growing season. There was much cloudy weather from August 24 onward to the close of the season. In 1908 the maximum temperature was high, and the precipitation after July 25 very light. This combination of drouth and heat accompanied by a fair amount of sunshine, furnished conditions favorable to the development of foliage "tip-burn." It is believed that the striking results following the use of bordeaux is in large measure due to the protecting film of spray material with which the leaf surfaces were covered.


Year 1906
92°
88°
84°
80°
76°
72°
68°
64°
60°
56°
52°
48°
44°
40°
36°
1"
2"
1"
Rainfall
1 July
10
20
1 August
10
20
1 September
10
20
30
Early Blight harmful in some fields
Spreads rapidly to Aug 1.
Late Blight appears first July 21
Late Blight is checked in its spread


Year 1907
Late Blight develops in some fields during rainy September
Tip burn and Early Blight develop on sandy soils.
1 July
1 August
1 September
Rainfall


Year 1908
Tip burn injury serious.
Very little Early Blight.
No Late Blight.
1 July
1 August
1 September
Rainfall.

Various theories have been advanced in explanation of the beneficial effects accruing from bordeaux mixture spraying. Lutman[1] states that the increased vigor of the plants as shown by the larger yield seemed due to the effect of the copper on the leaves. Two physiological effects of the copper on the plants were noted:

(1) The bordeauxed leaves were thicker and of a darker green color than those which were left unsprayed, apparently indicating that the plant was healthier, and that on account of its greater amount of chlorophyll it was producing more starch.

(2) The plants thus treated suffered less from tip-burn than did those not bordeauxed and lived from ten days to two weeks longer, apparently indicating that transpiration was retarded.

The writer has long held that the beneficial action of bordeaux applications is of a three-fold nature:

(1) That, as has just been quoted, it checks transpiration, thus enabling the plant to pass through protracted seasons of heat, drouth or both without suffering serious foliage injury, as is evidenced by freedom from tip-burn.

(2) That in seasons of intense sunlight and high temperature, the normal function of the chlorophyll in unprotected leaves is more or less seriously interrupted; and that the thin copper film formed on the leaves by bordeaux applications so modifies the effect of the intense sunlight as to enable the chlorophyll to maintain its normal activity, thus favoring a maximum production of carbohydrates.

(3) That sprayed plants are enabled to live out a normal life.

Chart I (page 176) portrays graphically the relative yields for 1906, 1907 and 1908. The 3-year average yield of merchantable tubers from the sprayed plants should be especially noted. It is slightly more than double that from the unsprayed crop.

The effects of bordeaux mixture on late maturing and supposedly disease resisting varieties of both foreign and American origin are displayed in table VIII (page 177) covering the three seasons.

[1]Vt. Sta. Bul. 159, p. 220 (1911).

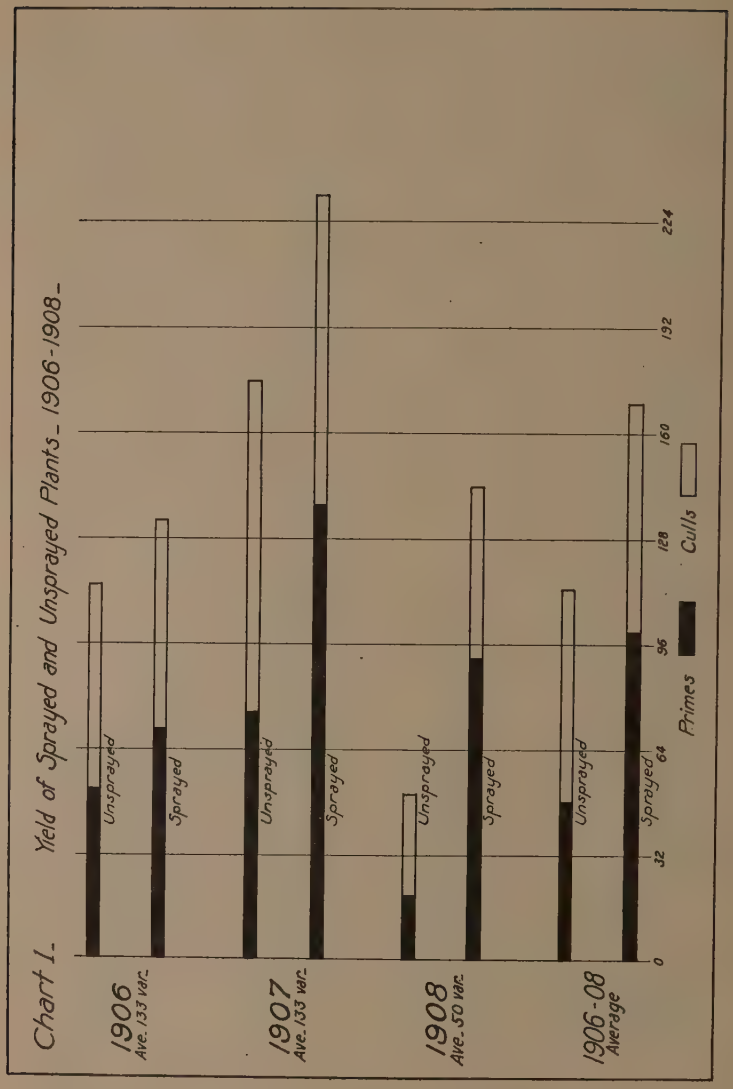


Chart 1. Yield of Sprayed and Unsprayed Plants 1906-1908
1906 Ave. 133 var.
1907 Ave. 133 var.
1908 Ave. 50 var.
1906-08 Average
Unsprayed
Sprayed
Primes
Culls
0
32
64
96
128
160
192
224

TABLE VIII—YIELD IN BUSHELS PER ACRE OF PRIMES AND CULLS FROM SPRAYED AND UNSPRAYED PLANTS, SEASONS OF 1906, 1907 AND 1908

Accession number	Name of variety	1906				1907				1908				Average percent gain in favor of sprayed plants	
		Sprayed		Unsprayed		Sprayed		Unsprayed		Sprayed		Unsprayed			
		Primes	Culls	Primes	Culls	Primes	Culls	Primes	Culls	Primes	Culls	Primes	Culls	Primes	Total yield
501	Sophie	100.8	63.0	25.2	80.6	99.8	90.8	16.1	100.3	126.0	117.0	3.3	19.0	632	103
505	Irene	35.3	126.0	5.0	62.8	68.5	157.3	8.1	159.7	53.4	136.1	0.	46.9	1106	105
508	Max Eyth	47.9	85.7	23.5	95.8	79.6	146.1	24.2	137.1	62.5	93.8	3.0	68.6	275	46
509	Mohort	90.8	126.0	67.2	42.0	201.6	153.2	64.0	144.1	81.6	92.8	0.	63.5	185	96
510	Gastold	46.1	173.0	30.2	57.1	134.5	166.4	39.1	204.3	87.7	141.2	0.	109.9	287	70
511	President Kruger	167.3	60.5	94.1	97.4	298.4	125.9	156.7	165.7	133.1	88.7	26.2	93.7	116	38
517	Apollo	20.2	71.8	1.3	54.6	47.4	95.8	21.2	97.8	32.3	92.7	0.	7.1	344	98
558	White Blossom	100.8	65.5	42.0	62.7	209.7	165.3	74.6	123.0	120.1	81.6	8.1	69.5	245	96
610	Blight Proof	257.	29.0	109.2	47.9	161.3	55.5	209.7	30.7	138.1	65.5	4.0	24.2	72	66
617	Late Blightless	143.6	13.9	50.4	22.7	232.9	42.4	137.9	34.8	155.2	53.4	8.1	23.1	171	132
633	Unnamed	158.8	46.7	120.2	56.6	274.2	70.5	177.4	70.5	146.2	97.8	28.2	66.5	78	52
653	Rural Blush	163.8	39.1	124.3	69.8	237.9	36.3	84.7	114.9	169.3	54.5	23.2	76.7	161	52
669	Manly	103.3	37.7	47.9	35.3	181.4	47.4	118.9	65.5	259.1	58.5	26.2	47.4	182	101
	Total yield	1435.7	937.9	740.5	785.3	2227.2	1352.9	1132.6	1448.4	1564.6	1173.2	130.3	716.1		
	Average yield	110.4	72.1	57.0	60.4	171.3	104.1	87.1	111.4	120.4	90.2	10.0	55.1		

The yields of primes and culls from the sprayed and unsprayed plants of each variety and for each season are shown. The 3-year average percentage of gain in primes and total yields for each variety are shown at the right, while the footings give the total and average yields. It should be noted that the 3-year average gains of primes as a result of spraying range from 72 percent to 1106 percent. The lowest average total gain is 46 percent and the highest 132 percent. The following data display the average yield and percent of gain of 13 varieties for each season, together with the average for the three seasons.

The averages appearing (table VIII) are rearranged for ready comparison below.

Year	Times sprayed		Sprayed bushels	Unsprayed bushels	Increase %
1906	Twice	Primes	110.4	57.	93.9
		Culls	72.1	60.4	...
		Total	182.5	117.4	55.5
1907	Thrice	Primes	171.3	87.1	96.7
		Culls	104.1	111.4	...
		Total	275.4	198.5	38.7
1908	Five times	Primes	120.4	10.0	1104.1
		Culls	90.2	55.1	...
		Total	210.6	65.1	223.5
Average 1906-1908		Primes	134.	51.4	160.7
		Culls	87.9	75.6	.....
		Total	221.9	127.	74.7

But little relative difference appears in the percentages of increases obtained from the 1906 and 1907 sprayings. The 1906 gain in primes or merchantable tubers was 93.9 percent; in 1907 it was 96.7 percent; and the total gains were 55.5 and 38.7 percents. These results are somewhat at variance with those afforded by the 133 varieties where the increases in 1906 and 1907 in primes were 34.6 and 83.2 respectively; and total crops, 16.5 and 32.3 percent. It should be remembered that the 13 varieties were a part of the 133 and of the 50 varieties previously tabulated (page 170). The divergencies are simply due to differences in varietal response to fungicidal treatment under identical soil and climatic conditions. The 13 varieties were well distributed throughout the field. Neither position, soil nor moisture could have been controlling factors.

When the 1908 data are considered we at once note a marked influence from spraying. The gain in primes exceeds 1100 percent and the total gain is 223.5 percent. The maintenance of the health and vigor of the sprayed plants entailed an increased yield of merchantable tubers, twelve times greater than that on the unsprayed plants, while the total yield was more than doubled. The average gain for the three seasons exceeds 100 percent on primes and is almost 50 percent on total yield. The average seasonal yields and the combined average yield of the three seasons are graphically expressed in chart II (page 180), while the individual behavior of the varieties for 1908 is expressed in chart III (page 181). Figure 6 gives a near view of sprayed and unsprayed Manly plants photographed on September 9, 1908. The sprayed area was a mass of living green, the unsprayed plants were practically all dead. Figure 7 shows the tubers harvested from these plants. The arrangement of the tubers for photographing was unfortunately in reverse order of that obtaining in the field. Figure 8 shows the results secured from Apollo, one of the German varieties which showed very distinct disease resisting qualities, but which consistently gave low yields throughout all the years during which it was under trial. While the yield is not so great, the difference between the yield from sprayed and unsprayed plants is perhaps the more striking in that the unsprayed plants did not produce a single tuber weighing as much as an ounce and a half.

The results of these trials would seem to warrant the following statements:

1. That it pays to spray potato vines with bordeaux mixture in seasons in which no blight occurs.

2. That some varieties respond better to spraying than do others.

3. That climatic conditions of heat, moisture and sunshine modify the outcome when bordeaux is used, according as one or the other of these factors depart from normality.

4. That the beneficial effects of bordeaux application may be attributed to three factors, viz.:

(*a*) To diminished transpiration.

(*b*) To the maintenance of optimum light intensity in seasons of bright sunshine and heat, thus permitting the uninterrupted action of the chloroplastids.

(*c*) To a lengthened season of growth.

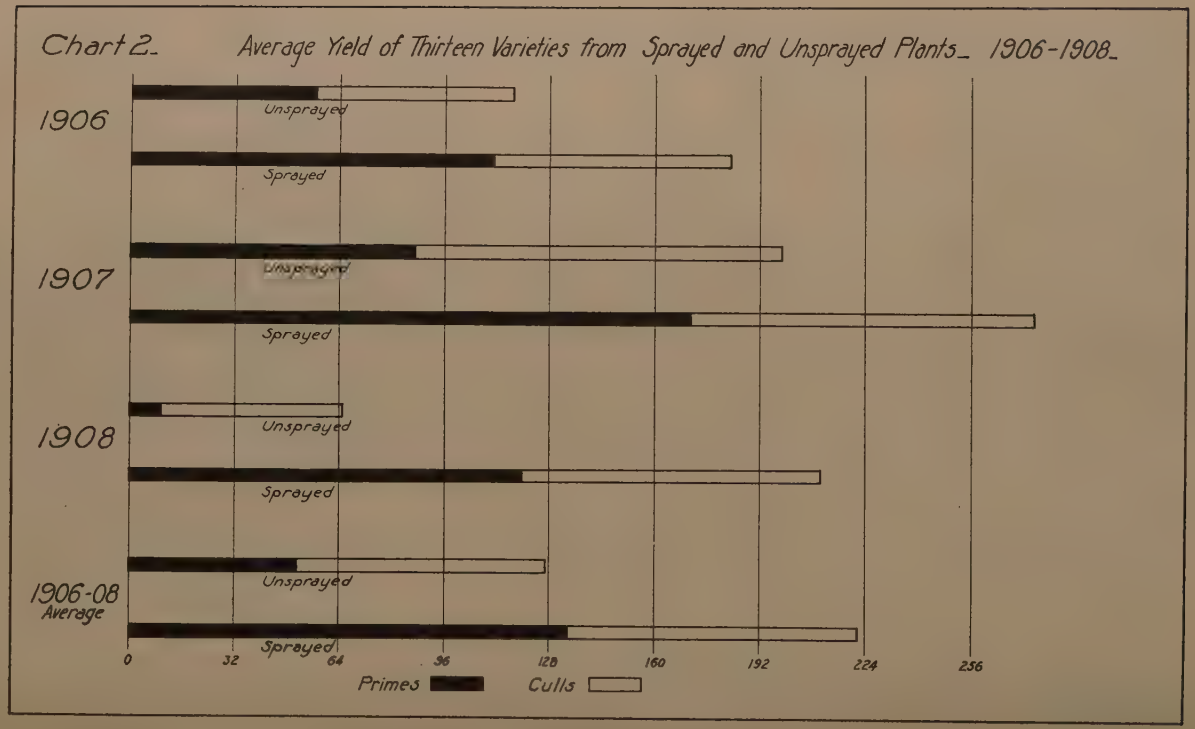


Chart 2. Average Yield of Thirteen Varieties from Sprayed and Unsprayed Plants. 1906-1908.
1906
Unsprayed
Sprayed
1907
Unsprayed
Sprayed
1908
Unsprayed
Sprayed
1906-08 Average
Unsprayed
Sprayed
0
32
64
96
128
160
192
224
256
Primes
Culls

6. VALUE OF FOREIGN VARIETIES OF POTATOES

Several years' observation of the behavior of foreign varieties under American soil and climatic conditions have served to demonstrate that with but few exceptions they are very unsatisfactory as judged by our commercial standards. As a rule the yield of merchantable tubers is too small and the proportion of culls too large; and there is no profit in them. The few varieties which have proven moderately satisfactory are Factor, Up-to-date, Northern Star and Mohort. The first three are of British and the last of German origin. For the most part the German and Dutch varieties which have come under our observation have produced tubers of inferior table quality, inclined to be more or less rough or deep-eyed, and too small to be merchantable. This has been particularly true of those which were imported especially for their high disease resistant qualities. It would seem as if high disease resistance of the vine was correlated with low and undesirable tuber yields.

In general it was found that the imported varieties set more tubers per plant than our American varieties under similar conditions. The average number of tubers produced per plant by 24 German and Dutch varieties during the seasons of 1905 to 1908 inclusive was 11.8. During the same period 11 British varieties produced an average of 12.7 tubers, while 20 American varieties averaged to yield 8.3 tubers. The average number of merchantable tubers per plant was: German and Dutch varieties 2.1, British 3.3, American 3.5 tubers. The data on which these statements are based appear in the closing tables. This low average number of merchantable tubers per plant seems largely due to the fact that the varieties were grown on a light sandy loam soil deficient in humus and not too abundantly supplied with artificial plant food.

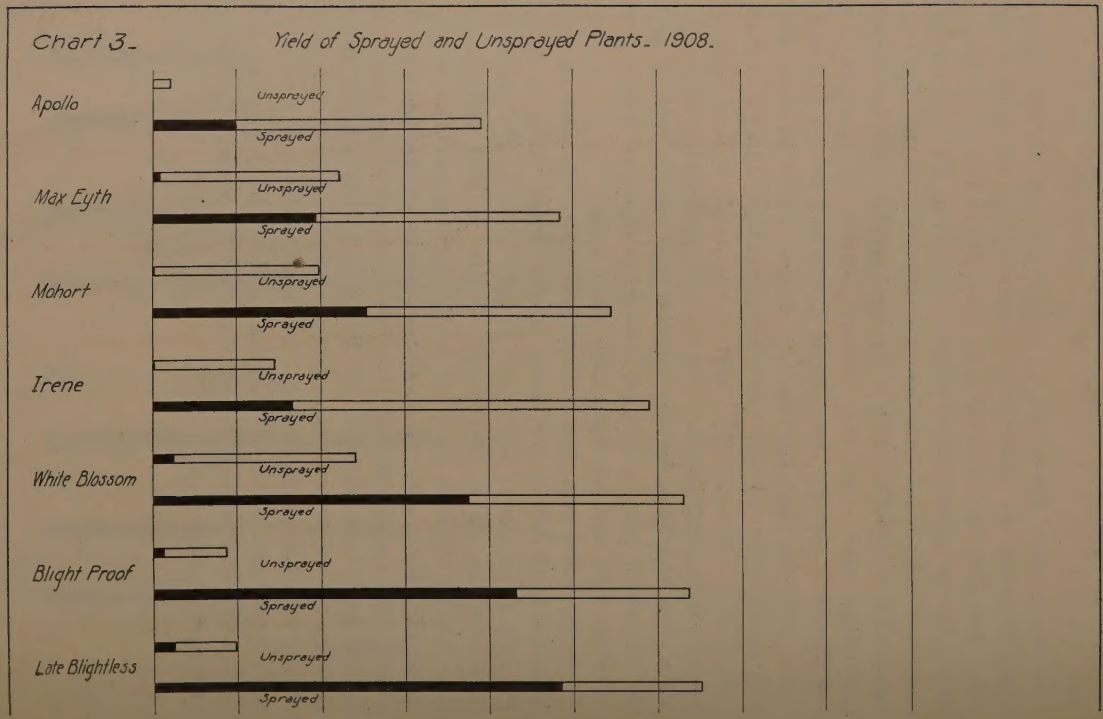
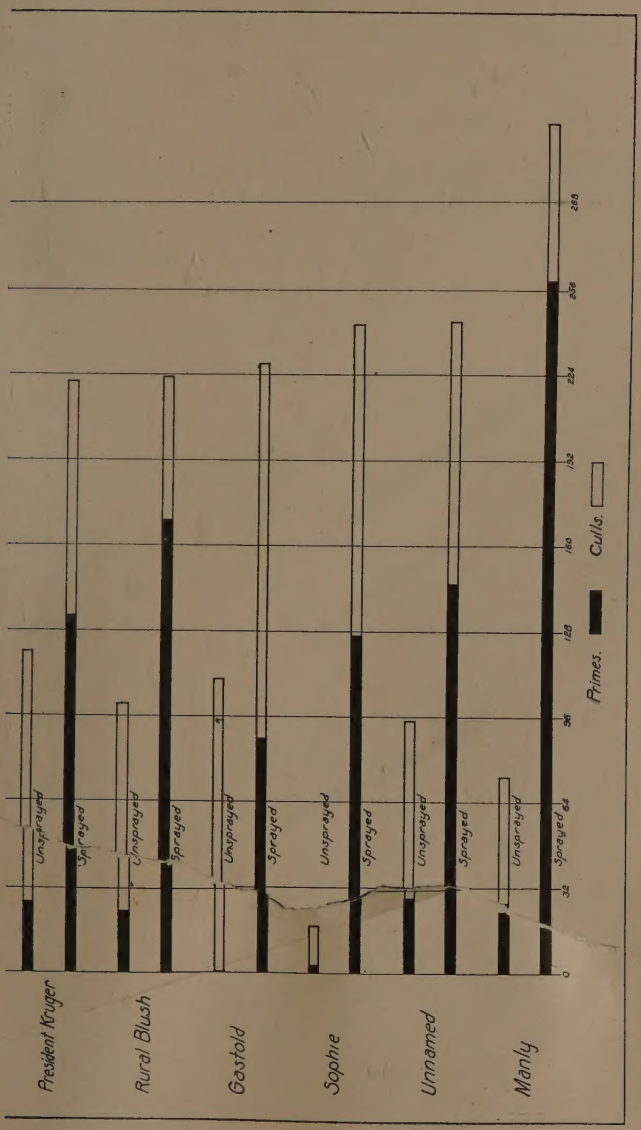


Chart 3.
Yield of Sprayed and Unsprayed Plants. 1908.
Apollo
Unsprayed
Sprayed
Max Eyth
Unsprayed
Sprayed
Mohort
Unsprayed
Sprayed
Irene
Unsprayed
Sprayed
White Blossom
Unsprayed
Sprayed
Blight Proof
Unsprayed
Sprayed
Late Blightless
Unsprayed
Sprayed


President Kruger
Rural Blush
Gastold
Sophie
Unnamed
Manly
Unsprayed
Sprayed
Primes.
Culls.
0
32
64
96
128
160
192
224
256
288